

Three newly recorded species of the genus *Diphascon* (Tardigrada; Hypsibiidae) from China

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Abstract: This paper reports three newly recorded species, *Diphascon modestum* Binda, Pilato and Dastych, 1984, *Diphascon nobilei* Binda, 1969, and *Diphascon triodon* Maucci, 1996, of the genus *Diphascon* (Tardigrada; Hypsibiidae) from China. Five specimens of *Diphascon modestum* were collected from Taibai Mt. (34°18'N, 107°42'E) at 2,500 m above the sea level (a.s.l.), two specimens of *Diphascon nobilei* were collected from Tonggu County, Jiangxi Province (28°31'N, 114°26'E) at 900 m a.s.l., and one specimen of *Diphascon triodon* was collected from Linzhi County, Tibet (29°40'N, 94°23'E) at 3,500 m a.s.l. All specimens are deposited at the College of Life Sciences, Shaanxi Normal University, China. A key to the Chinese species of *Diphascon* was also given.

Keywords: *Diphascon modestum*; *Diphascon nobilei*; *Diphascon triodon*; new record; taxonomy; tardigrada

Introduction

Over 74 species of the genus *Diphascon* have been described in the world (Guidetti & Bertolandi 2005). Up to now, however, only eight species of this genus were reported from China (Li et al. 2007). In this paper, three newly recorded species, *Diphascon modestum* Binda, Pilato and Dastych, 1984; *Diphascon nobilei* Binda, 1969 and *Diphascon triodon* Maucci, 1996 were reported. A key to the species of *Diphascon* of China was also given.

Materials and methods

Tardigrades were extracted from mosses collected from Mt. Taibai, Shaanxi Province, Tonggu County, Jiangxi Province and Linzhi County, Tibet. All specimens were mounted in Hoyer's medium on microscope slides for identification, and the coverslips were sealed with epoxy paint. Observation and measurements were made using phase contrast microscopy (PCM) (Leica DM LB2) and an eyepiece micrometer. Photomicrographs were made using PCM associated with a digital camera (Leica DFC Twain 6.1.1). *pt* is the percent ratio of the length of a given structure to the length of the buccal tube measured from the me-

dio-dorsal transversal ridge of the buccal armature to the base of the pharyngeal apophyses (Pilato 1981). The specimens are deposited at the College of Life Sciences, Shaanxi Normal University, China.

Taxonomic accounts

Class Eutardigrada Marcus, 1927

Order Parachela Schuster, Nelson, Grigarick, & Christenberry, 1980

Family Hypsibiidae Pilato, 1969

Genus *Diphascon* Plate, 1889

Subgenera *Adropion* Pilato, 1987

Diphascon modestum Binda, Pilato and Dastych, 1984
(Figs 1–2, Table 1)

Material examined: Five specimens were collected from Taibai Mt (34°18'N, 107°42'E) at 2,500 m above the sea level.

Description: Length up to 300 μ m (Table 1), colorless, cuticle smooth, eyespot absent. The bucco-pharyngeal tube without the "drop" formation, the flexible pharyngeal tube a little shorter than the pharynx, slender, with diameter less than 1.5 μ m (Fig. 1).

Pharynx oval and elongated, containing three rod-shaped macroplacoids with length increasing from the first to third. Microplaciod and septula absent (Fig. 1).

Legs short and small, ended with double claws different in shape and size. The principal branch of the external double claws inserted at about the middle of the secondary branch, the internal double claws smaller and the two branches form between them a larger angle than in the external double claws. The principle branches of all the double claws with two little accessory points, all legs without cuticular bar (Fig. 2).

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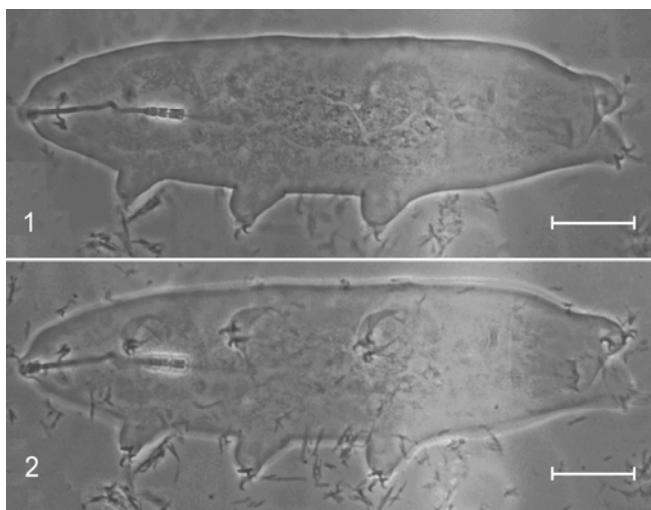
Remarks: The species was first found in Tatra Mountains, Poland (Binda 1984). Subsequently, it was reported from British Co-

lumbia, Canada (Kathman 1990). It is the first report of this species from China.

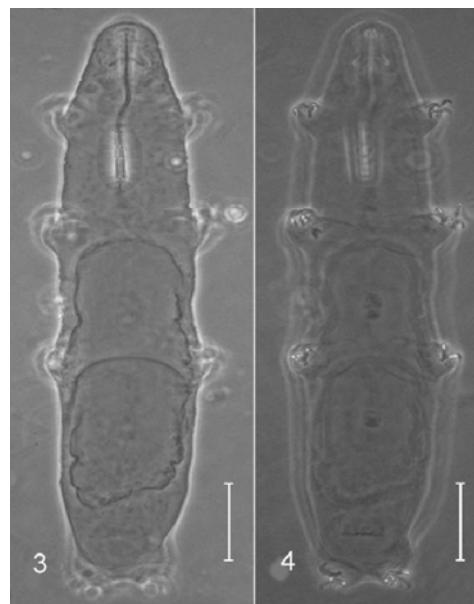
Table 1. Measurements of *Diphascon modestum* *

Character	LMI		SMI		Mean \pm SD (n=5)	
	μm	pt	μm	pt	μm	pt
Body length	297		206		242.13 \pm 12.17	
Buccal tube length	24.80		21.66		23.10 \pm 0.36	
Stylet support insertion point	16.19	65.26	14.36	66.27	15.11 \pm 0.26	65.39 \pm 0.39
Buccal tube width	1.57	6.32	1.31	6.02	1.34 \pm 0.09	5.77 \pm 0.34
Pharyngeal tube length	33.15	133.68	32.36	149.40	32.56 \pm 0.17	141.14 \pm 1.76
Bucco-pharyngeal tube length	57.94	233.68	54.03	249.40	55.66 \pm 0.49	241.14 \pm 1.76
1st macropalacoid length	3.13	12.63	2.61	12.05	2.81 \pm 0.07	12.14 \pm 0.12
2nd macropalacoid length	3.92	15.79	3.13	14.46	3.36 \pm 0.09	14.54 \pm 0.25
3nd macropalacoid length	6.79	27.37	6.00	27.71	6.10 \pm 0.14	26.40 \pm 0.36
Placoid row length	15.14	61.05	13.57	62.65	14.14 \pm 0.23	61.23 \pm 0.46
Leg 1 external claw primary branch length	9.14	36.84	8.09	37.35	8.42 \pm 0.14	36.44 \pm 0.25
Leg 1 external claw secondary branch length	5.48	22.11	4.70	21.69	4.89 \pm 0.12	21.18 \pm 0.31
Leg 1 internal claw primary branch length	6.26	25.26	6.00	27.71	5.92 \pm 0.10	25.65 \pm 0.35
Leg 1 internal claw secondary branch length	4.18	16.84	3.65	16.87	3.88 \pm 0.08	16.81 \pm 0.22
Leg 2 external claw primary branch length	10.18	41.05	8.87	40.96	9.27 \pm 0.19	40.11 \pm 0.48
Leg 2 external claw secondary branch length	6.00	24.21	5.22	24.10	5.42 \pm 0.12	23.44 \pm 0.29
Leg 2 internal claw primary branch length	7.05	28.42	6.53	30.12	6.62 \pm 0.18	28.66 \pm 0.54
Leg 2 internal claw secondary branch length	4.70	18.95	4.18	19.28	4.27 \pm 0.11	18.50 \pm 0.32
Leg 3 external claw primary branch length	11.22	45.26	9.66	44.58	10.11 \pm 0.24	43.77 \pm 0.66
Leg 3 external claw secondary branch length	6.79	27.37	5.74	26.51	5.97 \pm 0.14	25.84 \pm 0.35
Leg 3 internal claw primary branch length	7.83	31.58	7.05	32.53	7.24 \pm 0.20	31.34 \pm 0.57
Leg 3 internal claw secondary branch length	5.22	21.05	4.70	21.69	4.76 \pm 0.13	20.62 \pm 0.42
External claw 4 primary branch length	12.53	50.53	10.18	46.99	11.06 \pm 0.29	47.84 \pm 0.76
External claw 4 secondary branch length	7.57	30.53	6.00	27.71	6.59 \pm 0.21	28.49 \pm 0.53
Internal claw 4 primary branch length	9.14	36.84	7.83	36.14	8.06 \pm 0.22	34.86 \pm 0.57
Internal claw 4 secondary branch length	5.74	23.16	4.96	22.89	5.19 \pm 0.13	22.45 \pm 0.32

* LMI, the largest measured individual; SMI, the smallest measured individual; SD, standard deviation.



Figs. 1-2 *Diphascon modestum* Binda, Pilato and Dastych, 1984; 1. Habitus focused to show the bucco-pharyngeal apparatus; 2. Habitus focused to show the double claws. 1-2. Scale bars = 40 μm .



Figs. 3-4 *Diphascon triodon* Maucci, 1996; 3. Habitus focused to show the bucco-pharyngeal apparatus; 4. Habitus focused to show the double claws. 3-4. Scale bars = 50 μm .

Subgenera *Diphascon* Pilato, 1987
Diphascon nobilei Binda, 1969 (Table 2)

Material examined: Two specimens were collected from Tonggu County, Jiangxi Province (28°31'N, 114°26'E) at 900 m above the sea level.

Description: Length up to 280 μm , colorless, cuticle smooth, eye spots present. The bucco-pharyngeal tube with the “drop” formation, the flexible pharyngeal tube little shorter than the pharynx, slender, with diameter about 1–2 μm .

Pharynx elongated, containing the apophyses and 3 macroplacoids (slender-rod shaped), of which the second shortest and the third longest; microplaciod present, septula absent.

Legs short and large, with double claws different in shape and size; the external double claws, robust, with the principal branch inserted at about the middle of the secondary branch, the internal double claws, also robust, smaller than in the external double claws; the basal part of the double claws on the fourth pair of legs, much robust, considerably expanded in the proximal part with robust teeth (about 8 to 10 teeth); the principle branches of all the double claws with obvious accessory points; a smooth cuticular bar present near the base of the internal double claws on the first three pair of legs,

Remarks: *Diphascon nobilei* was first observed in moss from Sicily (Ramazzotti & Maucci 1983). It is the first report of this species from China.

Table 2 Measurements of *D. nobilei*

Character	Specimen 1		Specimen 2	
	μm	μm	μm	μm
Body length	228		276	
Buccal tube length	30.28		31.84	
Stylet support insertion point	18.79	62.07	19.84	62.30
Buccal tube width	1.83	6.03	2.09	6.56
Pharyngeal tube length	61.60	203.45	63.16	198.36
Bucco-pharyngeal tube length	91.87	303.45	95.01	298.36
1st macroplacoid length	7.31	24.14	7.57	23.77
2nd macroplacoid length	6.79	22.42	7.05	22.13
3rd macroplacoid length	8.87	29.31	9.40	29.51
Microplacoid length	0.78	2.59	0.78	2.46
Placoid row length	26.62	87.93	28.19	88.52
Leg 1 external claw primary branch length	13.57	44.83	14.09	44.26
Leg 1 external claw secondary branch length	8.09	26.72	8.35	26.23
Leg 1 internal claw primary branch length	10.70	35.34	10.96	34.43
Leg 1 internal claw secondary branch length	6.79	22.42	7.05	22.13
Leg 2 external claw primary branch length	15.14	50.01	15.66	49.18
Leg 2 external claw secondary branch length	9.14	30.17	9.66	30.33
Leg 2 internal claw primary branch length	11.22	37.07	11.75	36.89
Leg 2 internal claw secondary branch length	7.31	24.14	7.57	23.77
Leg 3 external claw primary branch length	15.92	52.59	16.70	52.46
Leg 3 external claw secondary branch length	9.92	32.76	10.18	31.97
Leg 3 internal claw primary branch length	11.48	37.93	12.53	39.34
Leg 3 internal claw secondary branch length	7.57	24.99	8.09	25.41
External claw 4 primary branch length	16.70	55.17	17.49	54.92
External claw 4 secondary branch length	10.96	36.21	11.22	35.25
Internal claw 4 primary branch length	12.01	39.66	13.31	41.80
Internal claw 4 secondary branch length	8.09	26.72	8.61	27.05

Subgenera *Adropion* Pilato, 1987
Diphascon triodon Maucci, 1996

Material examined: Only one specimen was collected from Linzhi County, Tibet (29°40'N, 94°23'E) at 3,500 m above the sea level.

Description: Length 345 μm . Body slender, mouth in a terminal position. Colorless, smooth cuticle. Eyespots absent. The bucco-pharyngeal tube thin (2.09 μm , $pt=6.25$) and with an overall length of 79.34 μm ($p=237.47$) (33.41 μm for the rigid buccal tube, 45.94 μm ($p=137.51$) for the pharyngeal tube length). The stylet supports inserted at 20.36 μm ($pt=60.94$). The stylet thin, with a large furca. The “drop-like” formation absent. Pharynx

elongated. The apophyses every small. Three very thin macroplacoids respectively 10.7 μm ($pt=32.03$), 7.31 μm ($pt=21.88$), and 12.53 μm ($pt=37.51$) in length. The microplacoids (1.31 μm , $pt=3.92$) very small and thin. Septula absent. The total placoid row 32.89 μm ($pt=98.44$) in length (Fig. 3).

The claws of each leg differ greatly from one another. The external claw with a strong common branch, the main branch long, thin with small accessory points, the secondary branch strong and moon-shaped. The internal claw smaller, with the common branch expanded at the base. Cuticular thickening absent at the claw base (Fig. 4).

The primary branch of the external claw on the first pair of legs 12.53 μm ($pt=37.51$) in length, secondary branch 8.35 μm

($pt=24.99$) in length; the primary branch of the internal claw 10.96 μm ($pt=32.81$) in length, secondary branch 6.79 μm ($pt=20.31$) in length. The primary branch of the external claw on the secondary pair of legs 16.97 μm ($pt=50.78$), secondary branch 10.78 μm ($pt=30.47$) in length; the primary branch of the internal claw 12.01 μm ($pt=35.94$) in length, secondary branch 8.09 μm ($pt=24.22$) in length. The primary branch of the external claw on the third pair of legs 17.75 μm ($pt=53.13$) in length, secondary branch 11.75 μm ($pt=35.16$) in length; the primary branch of the internal claw 12.53 μm ($pt=37.51$) in length, secondary branch 8.87 μm ($pt=26.56$) in length. The primary branch of the posterior claw on fourth pair of legs 18.79 μm ($pt=56.25$) in length, secondary branch 12.53 μm ($pt=37.51$) in length; the primary branch of the anterior claw 14.62 μm ($pt=43.75$) in length, secondary branch 10.18 μm ($pt=30.47$) in length.

Remarks: This species was described from arctic tundra (Maucci 1996). It is the first report of this species from China.

Key to the species of *Diphascon* of China

1. Cuticle sculptured or with gibbosities..... 2
Cuticle smooth..... 3
2. Pharynx with two macroplacoids..... *D. bisbullatum*
Pharynx with three macroplacoids..... *D. clavatum*
3. “Drop” formation present..... 4
“Drop” formation absent..... 7
4. Microplacoid and septula present..... 5
Microplacoid present, septula absent..... *D. nobilei*
5. Length of macroplacoids increaseing from first to third..... 6
Macroplacoids about equal in length..... *D. chilenensis*

6. Body rather narrow and elongated..... *D. alpinum*
Body wide and squat..... *D. pingue*
7. Pharynx with two macroplacoids..... *D. rivulare*
Pharynx with three macroplacoids..... 8
8. Microplacoid or septula present..... 9
Microplacoid and septula absent..... 10
9. Microplacoid and septula present..... *D. scoticum*
Microplacoid present, septula absent..... *D. triodon*
10. The first two macroplacoids about equal in length..... *D. modestum*
The first two macroplacoids different in length..... *D. prosirostre*

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